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Acoustics Considerations

2-10 Anderson Street / 47-55 Bunnerong Road, Kingsford

The site at No. 2 to No. 10 Anderson Street & No. 47 to No. 55 Bunnerong Road, Kingsford, has an area of about 6,000 square metres, and extends back 95 meters from the Bunnerong Road boundary & 70 metres from the Anderson Street boundary.

The site is impacted by aircraft noise, road traffic noise, and by noise emissions from nearby electrical transformers.

Aircraft Noise

Under the list of Directions issued by the Minister of Planning as Local Planning Directions, under *5.3 Development Near Regulated Airports and Defence Airfields*, Direction 5.3 (4a) required that the development comply with *Australian Standard 2021-2015 Acoustic – Aircraft Noise Intrusion – Building siting and construction* with respect to internal noise levels, where the residential development lies between the Australian Noise Exposure Forecast (ANEF) 20 and 25 contours of a regulated airport.

Sydney Airport is located to the west southwest. The East-West Runway flight path passes about 75 metres to the south-south-east of the site. The departure flight path from the eastern end of the East-West Runway is on a heading 74 degrees east of true north.

According to data supplied by Randwick City Council, the site is within an area bounded by the 2033 ANEF contour of the Sydney Kingsford-Smith Airport. The site must therefore be assessed in accordance with the requirements of AS 2021-2015.

> According to AS 2021-2015, arrivals will expose the site to $L_{Amax(slow)}$ noise levels of up to 86 dB(A)
>
> According to AS 2021-2015, departures will expose the site to $L_{Amax(slow)}$ noise levels of up to 87 dB(A).

Orientation of the Bunnerong Road facades should see the actual exposures reduced to 79 dB(A). Orientation of the Anderson Street facades should see the actual exposures reduced to 82.7 dB(A).

Internal noise limit is $L_{Amax(slow)}$ levels of 50 dB(A) or less in “bedrooms and dedicated lounges”, 55 dB(A) or less in “other habitable areas”, and 60 dB(A) or less in “bathrooms, toilets, laundries”.

Road Traffic Noise

Bunnerong Road is 4-lanes wide (about 13.5 metres), with the property boundary set back about 9.5 metres from the kerb. Along Bunnerong Road, the building facades have setbacks of about 5.6 metres, and about 19 metres from the Bunnerong Road property boundary.

> Close to the facade, ‘worst case’ Bunnerong Road, (peak hour period) ‘free field’ $L_{Aeq,1hour}$ noise level is likely to be 69.6 dB(A) at 5.6 metres from the property boundary.
>
> Close to the facade, ‘worst case’ Bunnerong Road, (peak hour period) ‘free field’ $L_{Aeq,1hour}$ noise level is likely to be 67.4 dB(A) at 19 metres from the property boundary.

The facades fronting Anderson Street are at 33 degrees to the perpendicular to Bunnerong Road.

> View angle will reduce their exposure by 1.65 dB(A). Along Anderson Street, (peak hour period) ‘free field’ $L_{Aeq,1hour}$ noise level will further diminish with distance from Bunnerong Road, at a rate of 3 dB(A) per doubling of distance from Bunnerong Road.

The internal noise limit is an $L_{Aeq,1hr}$ of 35 dB(A) in bedrooms (10:00 pm to 7:00 am), with an internal noise limit of an $L_{Aeq,1hr}$ of 40 dB(A) in other habitable spaces.

> The first part of this criteria is based on an assumption that the so-called morning 'peak hour' only occurs between about 8:00 am & 9:00 am each week day morning. The fully established 'peak hour' period noise levels have been shifting earlier & earlier, moving backwards into the end of the night time period.
>
> The wording for the internal noise limit has also become more ambiguous. This was originally based on the "maximum repeatable 1 hour L_{Aeq}" within the night time period, to be consistent with the requirements of the Protection of Environment Operations Act 1997.

Consideration also needs to be given to exposure to L_{Amax} traffic noise levels, as potential causes of "sleep disturbance".

> For louder transient noise levels, provided the internal L_{Amax} is less than 50 to 55 dB(A), these transient L_{Amax} noise levels are unlikely to cause 'sleep level' changes.
>
> Close to the facade, 'worst case' Bunnerong Road, general traffic likely to produce 'free field' L_{Amax} noise levels up to 73 dB(A) at 5.6 metres from the property boundary, and 82 dB(A) from buses and heavier vehicles.
>
> Close to the facade, 'worst case' Bunnerong Road, general traffic likely to produce 'free field' L_{Amax} noise levels up to 68 dB(A) at 19 metres from the property boundary, and up to 77 dB(A) from buses and heavier vehicles.

Electrical Transformers

There are three (3) transformer enclosures located across the northern boundary. Two (2) of these enclosures hold transformers and associated equipment. These electrical transformers are described as "132/11 kV 50MVA zone transformers". This Ausgrid equipment appeared 2007 / 2008.

A requirement of their installation would have been compliance with then current environmental noise limits.

Each enclosure is about 10.5 metres wide by 16.5 metres long by 8.5 metres high. The long side of each enclosure is offset about 7.5 metres from the boundary, or about 18.5 metres from the nearest existing building on the site. The eaves height of these existing development site buildings is about 8.9 metres. This indicates that the transformer enclosure walls are providing a barrier effect of about 5 dB to the existing buildings.

Based on the available data, and the dimensions of the enclosures, this indicates that they were design for an environmental L_{A90} 'background' noise level of 33 dB(A). Due to tonality, the L_{Aeq} noise limit would thus have been, 33 dB(A) at the nearest potentially worst affected residences. Given the height of the existing buildings and the height of the enclosure, the existing buildings would have benefited from a 5 dB(A) barrier effect.

> When the proposed buildings exceed the 3-storey height, the 'barrier effect will be lost, for the upper levels, with the tonality of the transformers becoming audible.
>
> EPA requirements should be achievable for bedrooms at, and beyond, 25 metres from the northern boundary, with doors & windows open. Within that 25 metres setback, closure of doors & windows should be sufficient to reduce the tonal noise to within acceptable level, even at night.

Dominant Noise Sources Impacting Site

When calculating the Rw rating for each exposed area, there is an adjustment for floor/ceiling height, an adjustment for area as a fraction of floor area, and an adjustment for reverberation time & number of surfaces.

The calculation of Rw ratings for aircraft noise uses a different adjustment for reverberation time increasing its potential impact by 3.5 dB(A).

Most aircraft landings & take offs occur between 6:00 am & 11:00 am, with some landings allowed as early as 5:00 am and are normally restricted to the Main North-South Runway.

Aircraft noise is likely to impact the site only occur when the East-West Runway is in operation, and then only when the eastern end of the runway is required for arrivals & departures.

Road traffic noise is semi-continuous with the highest levels occurring during the extended morning and evening 'peak hour' periods.

The Rw rating will be controlled by level of aircraft noise intrusion.

Minimum Required Rw Ratings for Traffic Noise Intrusion

The selected Rw ratings will be controlled by each building's exposure to aircraft noise.

Until such time as detailed architectural plans are available, only indicative Rw ratings, based on broad assumptions, can be provided.

For each room, the noise intrusion is based on the volume of the room (room floor to ceiling height, and the room's floor area), the typical reverberation time for that type of room, the area of each external element making up the external surfaces of the room. and the individual Rw rating of each element.

For most rooms (except for the top floors where the roof area is included), a room will have one or two facades in the external envelope of the building, with the facades consisting of wall elements, window elements and or door elements.

Typically, the masonry wall elements have Rw ratings at, or above, 45 dB.

In terms of Rw ratings, the doors & windows are generally the weakest element of the façade, with the Rw ratings of the doors and windows being critically dependent on the area of each element.

To calculate indicative Rw ratings, the following assumptions have been made.

A typical room size has been assumed to be 4 metres by 5 metres (width 4 metres; depth 5 metres) with a floor-ceiling height 2.7 metres, giving external façade area of 10.8 square metres.

It has been assumed that each room will have either a window or balcony doors.

Three sizes have been used, to provide indicative Rw ratings:

- a window size of window size of 1.2 metres by 1.8 metres,
- a balcony door size of 2.7 metres by 2.4 metres,
- a balcony door size of 2.7 metres by 3.6 metres.

In those areas facing away from the flight path, 'sleeping areas' and 'dedicated lounges' would require that:

- the 1.2 metre by 1.8 metre window have an Rw rating of 34 dB or greater,
- the 2.7 metre by 2.4 metre balcony door have an Rw rating of 39 dB or greater,
- the 2.7 metre by 3.6 metre balcony door haven Rw rating of 40 dB or greater.

Along the Bunnerong Road frontage, 'sleeping areas' and 'dedicated lounges' would require that:

- the 1.2 metre by 1.8 metre window have an Rw rating of 34 dB or greater,
- the 2.7 metre by 2.4 metre balcony door have an Rw rating of 39 dB or greater,
- that the 2.7 metre by 3.6 metre balcony door haven Rw rating of 40 dB or greater.

Along the Anderson Street frontage, 'sleeping areas' and 'dedicated lounges' would require that:

- the 1.2 metre by 1.8 metre window have an Rw rating of 35 dB or greater,
- the 2.7 metre by 2.4 metre balcony door have an Rw rating of 40 dB or greater,
- the 2.7 metre by 3.6 metre balcony door haven Rw rating of 42 dB or greater.

In design of windows & sliding glass doors, Rw ratings of up to 27 dB can be achieved using solid single layer glazing.

Rw ratings of up to 36 dB can be achieved using single layer, laminated glass.

Rw ratings over 36 dB generally require double glazing, or a 'sound lock' arrangement.

For the roof areas over 'sleeping areas' & 'dedicated lounges' the roof are requires an Rw rating of 52 dB or greater, which should be readily achievable with concrete slab construction.

Noise Emissions

Just as there are constraints arising from noise entering the site, so there are constraints on noise within the site, and on noise emanating from the site.

> For each unit, mechanical ventilation of bathrooms, toilets, laundries and kitchens will require exhaust fans. If there's a 'make-up' air supply, it may also require supply fans.
>
> The level of noise emission will depend on the intake or discharge locations and on equipment selection.
>
> Each unit's supply inlet & exhaust outlet noise emissions need to be addressed, so as not to impact other units within the complex, and not to impact external neighbours.

The underground car park will most likely be provided with a car park exhaust system.

> Noise from the fan or fans within the car park exhaust system will be emitted from the car park exhaust discharge. Preferably the fans would be located within the car park to enable ready installation of noise mitigation measures close to the intake & discharge sides of the fans.
>
> The fan or fans will also feed noise, via the collection ductwork into the car park, and out (via the air intakes) into the car park. This in turn generates a reverberant sound field within this enclosed space, leading to noise break-out via the car park entrance.
>
> > This noise breakout needs to such as to not disturb residents in units above the car park driveway.
> >
> > Should the entrance to the drive way be fitted with security gate or door, such would need to be low noise and to be vibrationally isolated so as not to cause disturbance to units directly above.

Mechanical noise sources for heating & cooling are often placed in the corner of a balcony. Typically, a small unit air conditioner has a rated sound power level of about 65 dB(A).

> Individually, a small unit air conditioner would reduce to 30 dB(A) or less at 50 metres.
>
> Where a façade has multiple units per floor, and multiple floors, the sound will accumulate at any nearby receiver point. Collectively, in each direction, the accumulated noise level would be about 47 dB(A) at 50 metres.
>
> For a noise limit of say 35 dB(A) at the nearest potentially worst affected residential location, each air conditioner would require a noise reduction of about 12 dB(A), requiring an acoustic enclosure of some kind. Individual heat pump hot water units should be avoided for the same reasons.

A centralised external heat exchanger, or heat exchangers, centrally located on the building roof tops would be far more amenable to noise mitigation.

The general overall acoustic limit for mechanical noise emissions to site boundaries, and to other units within the site, is that these noise missions (cumulative) not exceed 'background + 5' during the daytime (7:00 am to 6:00 pm) and the evenings (6:00 pm to 10:00 pm) and that they be 'inaudible' within other habitable spaces between 10:00 pm at night and 7:00 am next morning.

Building Code of Australia

Within the building envelopes, the acoustic performance ratings of partitions, floors and ceilings, are set by the Building Code of Australia. The main requirements are as follows.

> For air borne sound, the requirement is for partitions, floors and ceiling, to have an Rw+Ctr rating of 50 dB or greater between sole occupancies.
>
> Unit entry doors are required to have an Rw rating of 30 dB between sole occupancy and internal common areas.
>
> For air borne sound, the requirement is for partitions to have an Rw rating of 50 dB or greater between sole occupancies and other area.
>
> For structure borne sound, the requirement floors to have an LnT,w rating of 62 dB or less between sole occupancies.
>
>> To avoid noise annoyance, due to footfall noise, this LnT,w should be reduced to 50 dB or less. Where furniture is liable to movement, that furniture should be fitted with sliders, or floor protectors.

Summary

Many of the noise sources are transient or of limited duration.

Acoustical design is required to address 'worst case' scenarios.

The design needs to provide residents with the ability to achieve acceptable internal noise levels through the closure of doors and windows, while not compromising ventilation requirements.

The design also needs to ensure that other units, and nearby residents, are not adversely affected by noise emissions within the site.

Brian Marston

Brian Marston – Principal Consultant
BGMA Pty Ltd

Professional Affiliations & Qualifications

A practicing Acoustical Consultant		since 1981
Full member	*Institution of Engineers Australia (IEAust)* & CPEng NER	since 1986
Full member	*Australian Acoustical Society (AAS)*	since 1988
Full Member	*Acoustical Society of America (ASA)*	since 2007

A member of the international professional body of acoustical consultants, the *National Council of Acoustical Consultants* since 1999